Variations in mineralogy of dust in an ice core obtained from Northwestern Greenland during the past 100 years

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Snow and ice on glaciers and the ice sheet in the Arctic contain windblown mineral dust derived from local sediments as well as distant deserts. Dust deposited on the ice sheet in the past can be obtained by ice core drilling, and the variations in its sources and transportation processes can be reconstructed by particle analysis of ice cores. In this study, we analyzed morphology and surface chemistry of mineral dust particles in an ice core drilled in Northwest Greenland with Scanning Electron Microscope (SEM, QUANTA FEG 450) and Energy Dispersive X-ray Spectrometer (EDS).

The ice core was drilled at the SIGMA-D site (N77°64', W59°12' [1]) of 2100 m a.s.l. in 2014. The length is 222.72 m and the estimated age at 113 m depth is 350 years before present . The ice samples were collected every five years in plastic bottles and freeze dried on a polycarbonate filter to concentrate micro-particles. Then, the filter was coated with platinum (Pt) for SEM analysis. Here we report the temporal variations in size distributions and compositions of the minerals during the past 100 years (A.D 1915-2013).

The SEM observation revealed that the mean size of mineral dust in the SIGMA-D ice core ranged from 1-3μm, which is similar to that of the other Greenland ice core dust that seems to be derived from distant deserts. This suggests that the SIGMA-D ice core contained mainly long–range transported wind-blown mineral dust. The EDS analysis also revealed the ice core contained mainly silicate minerals, especially clay minerals that showed compositional variation among the samples. For example, kaolinite, one of clay minerals, contents were lower in 1920-1945 compared with the other periods, whereas quartz and feldspar contents were three times higher. This indicates that minerals in the ice core were derived from multiple geological sources and the source areas might have changed since 1945. Based on the past temperature record, the global warming occurred from 1910 to 1945. Thus, the sources and transportation pathway of minerals on the ice sheet are likely to be affected by such a global climate change.

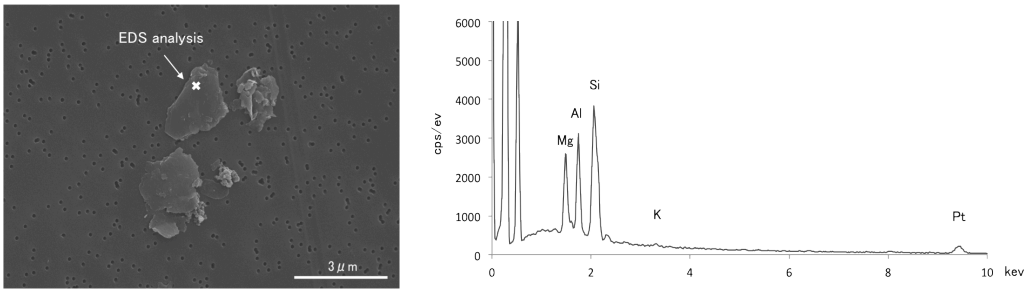

Figure 1. SEM image and EDS spectra of mineral dust in SIGMA-D ice core

References

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